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Applicant: NEC CORP

[Title Of The Invention]

SEMICONDUCTOR DEVICE

[Abstract]

**PURPOSE:** To prevent an Al layer from corroding for improving the moisture resistance, by making a two-layer pad electrode comprising the Al layer and a barrier metal layer.

**CONSTITUTION:** An Al layer 3 and a barrier metal layer 4 are accumulated in this order on an insulating film 2 formed on a semiconductor substrate 1 and selectively etched by turns to form a pad electrode comprising the Al layer 3 and the barrier metal layer 4 accumulated thereon. A layer insulating film 5 is accumulated on the surface including the pad electrode and an opening is made at the center of the layer insulating film 5 on the pad electrode. An Au ball formed by shaping the end of an Au wire in spherical form is stuck by thermocompression bonding on the barrier metal layer 4 of the opening and the Au wire on the Au ball is cut off by vibrating a capillary to form a bump electrode 6. This prevents the Al layer 3 from being corroded by water intruding into the surface of the Al layer 3 and the Au ball from coming off because of a brittle alloy produced on the boundary surface between the Al layer 3 and the Au ball.

[Claim(s)]

A semiconductor device comprising:

a pad electrode comprising a first metal layer consisting primary of Al formed on a insulating layer on a semiconductor substrate and a laminated layer of a second metal layer consisting of at least a barrier metal layer,

An interlayer insulating layer formed on the surface including the above pad electrode,

An opening formed on the above interlayer insulating layer at the center of the pad electrode,

A bump electrode formed by compression bonding of Au ball on the pad electrode of the opening.

[Detailed Description of the Invention]

[Industrial Application]

This invention relates to a semiconductor device, and more particularly, to a semiconductor device having a bump electrode.

[Description of the Prior Art]

As conventional TAB technology, there was a method that a bump electrode was formed via a laminated metal layer such as Pt/Ti, Au/Cu/Cr having a role for a barrier or improving a adhesive strength on a Al pad formed on a semiconductor chip and a lead was hot-welded by compression bonding or soldering on the bump electrode. As a forming method of the bump electrode, a method of forming a bump electrode which thickness is about  $20\mu\text{m}$  by plating Au or solder to a pad electrode formed on a semiconductor substrate was often applied. However, recently there is a method of forming a bump electrode formed by compression bonding of Au ball which formed on a edge of Au wiring on a pad electrode as a low cost method.

Fig. 3 is the cross section of the semiconductor chip to explain the example of the conventional semiconductor device.

An Al layer 3 is formed selectively on the insulator film 2 set up on the semiconductor circuit board 1

as the pad electrode. Next, an interlayer insulating film 5 is accumulated on the surface including the Al layer 3, and an opening is formed at the interlayer insulating film 5 in the center of the Al layer 3. After that, a bump electrode 6 is formed by compression bonding of Au ball which made the tip of the Au line a globular form on the Al layer 3 of the opening and cutting the Au line on the Au ball.

Fig. 4 shows the state of mounting that the lead 7 for TAB is compressively bonded on the bump electrode 6 of the Fig. 3.

#### [Problem(s) to be Solved by the Invention]

Due to the method of forming the bump electrode by compression bonding of the Au ball directly on the pad electrode consisting of Al layer, there was some problems in the above conventional semiconductor device, for example, purple plague caused by corrosion of the Al layer by moisture on the surface of Al layer and flaking (purple plague) owing to the frail alloy formed at the interface between the Al layer and the Au ball.

The aim of this invention is to provide a semiconductor device having a bump electrode improved the moisture resistance and adhesiveness at low cost.

#### [Means for Solving the Problem]

The semiconductor device of this invention comprising:

a pad electrode comprising a first metal layer consisting primary of Al formed on a insulating layer on a semiconductor substrate and a laminated layer of a second metal layer consisting of at least a barrier metal layer,

an interlayer insulating layer formed on the surface including the above pad electrode,

an opening formed on the above interlayer insulating layer at the center of the pad electrode,

a bump electrode formed by compression bonding of Au ball on the pad electrode of the opening.

#### [Example]

An embodiment of the present invention will be described with reference to the drawings.

Fig. 1 is the cross section of the semiconductor chip to explain the first example of this invention.

As shown in the Fig. 1, the Al layer 3 of  $1\mu\text{m}$  thickness on the insulating layer 2 formed on the semiconductor substrate 1 and the barrier metal layer of  $50\mu\text{m}$  thickness are accumulated in turn,

It accumulates one after another, and etching selectively one after another, and the pad electrode which consists of the lamination of the Al layer 3 and the barrier metal layer 4 is formed on the insulating film 2 set up on the semiconductor circuit board 1. The Al layer 3 can include Si, Cu, and so on, and the barrier metal layer 4 can use either such as Au/Ti, Pd/Ti, and Au/W/Ti.

The interlayer insulating layer 5 is accumulated on the surface including the pad electrode, and the opening is formed on the interlayer insulating layer 5 in the center of the pad electrode. Then, the AU ball which made the tip of the Au line a globular form on the barrier metal layer 4 of the opening part is compressively bonded, and the Au wiring on the Au ball is cut by producing a vibration in capillary and the bump electrode is formed.

Fig.2 is a cross section of the semiconductor chip to explain the second example of this invention.

As shown in the Fig. 2. the Cu layer 7 of  $1\mu\text{m}$  thickness on the surface including the opening is accumulated by forming the opening on the interlayer insulating layer in the center of the pad electrode as same process of the first embodiment.

#### [Effect of the invention]

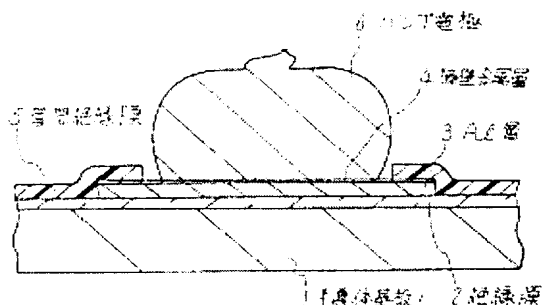
As described above, this invention can prevent the corrosion of the Al layer and improve the moisture resistance of the semiconductor device by making the pad electrode double-layered structure of the Al layer and the barrier metal layer. In addition, it has other effects to prevent the purple plague by entering the barrier metal layer between the Au ball and the Al layer, and to prevent a heat lock of the Al layer.

[Brief Description of the Drawings]

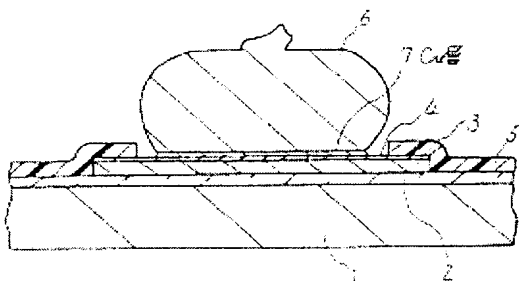
Fig. 1 and Fig. 2 are the cross sections of the semiconductor chip to explain the first and the second example of this invention. Fig. 3 is the cross section of the semiconductor chip to explain the example of the conventional semiconductor device. Fig. 4 is the cross section shown a state of mounting of the conventional semiconductor device.

[Description of Notations]

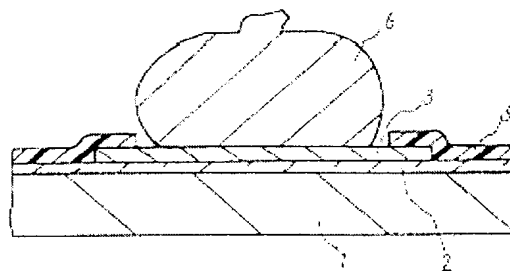
1. Semiconductor substrate 2. Insulating layer 3. Al layer 4. Barrier metal layer 5. Interlayer insulating layer 6. Bump electrode 7. Lead



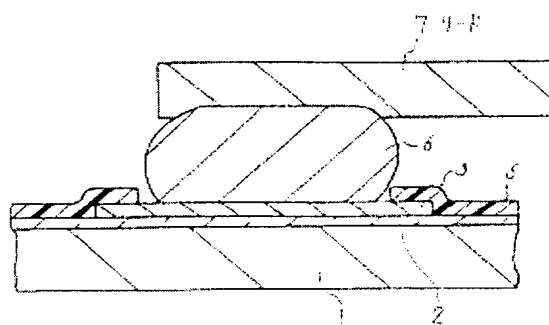
第 1 図



第 2 図



第 3 図



第 4 図